Space Weather Technical Forecast

Issued on Wednesday, 28 February 2024 at 01:09 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: Ongoing chance of M or X flares from AR3590 in the northwest.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Low with peak flare C3.4 at 27/0742 UTC from AR3590 in the northwest disc. This is the largest of six regions currently on the Earth-facing Sun, and remains a very large region with a clear and large delta spot configuration. There is some suggestion of some strengthening to this delta spot, along with a suggestion of a more sigmoidal structure to the magnetic looping of the spot in imagery such as SDO aia-94. Conversely, some slight reduction in penumbral area was observed, although this may be due to its increasing viewing angle. In the northeast AR3595 consolidated into an east-west aligned bipolar configuration, while AR3596 showed little change, persisting as a more north-sought aligned bipolar region. The other regions were smaller and simpler.

A CME was observed off the south centre disc in Stereo A cor2 imagery, due to the filament eruption from around 27/1100 UTC. Analysis is still underway for any Earth-directed component.

Solar Wind / Geomagnetic Activity: Solar winds eased after the recent weak coronal hole influence from CH01/-. Speeds, as recorded by ACE, eased from slightly elevated to be background, from peak 450 km/s to just below 400 km/s. Density also eased from remained around average to below average. Interplanetary magnetic field (IMF), Bt was moderate at first, peaking 8nT, but gradually eased to be weak from 27/0600 UTC, remaining below 5nT. The north-south component was initially moderately negative (southward directed), with minimum -8nT but eased to be more variable and weak from 27/0600 UTC, ranging -4 nT to +4nT. Phi angle was mainly (towards the Sun). Geomagnetic activity was Unsettled to Active (Kp3-4) 27/0000-27/0900 UTC with a G1 Minor Storm (Kp5) interval 27/0300-0600 UTC. Activity eased to Quiet to Unsettled (Kp0-3) from 27/0900 UTC.

Energetic Particles / Solar Radiation: GOES18 high energy (greater than 10MeV) proton flux was at background. High energy electron flux (greater than 2MeV) observed at GOES16 was also at background with the associated 24 hour fluence well below the Active (1e8 integrated pfu) threshold. The observed 24-hour fluence at 28/0000UTC was 1.18e6 integrated pfu.

Four-Day Space Weather Forecast Summary

Solar Activity: Low to Moderate activity expected with isolated M-class flares. There remains a slight chance of X-class flares from AR3590.

Solar Wind / Geomagnetic Activity: The CME from the filament eruption on 27 Feb is still under analysis, but appears likely to miss to the south with at most only a glancing impact on day 4 (02 Mar). Otherwise, no significant enhancements are expected with mainly background winds expected. Geomagnetic activity is likely to remain Quiet with only a chance of isolated Unsettled intervals.

Energetic Particles / Solar Radiation: GEOS18 high energy proton flux is likely to stay at background, but is likely to respond to any notable flares from AR3590, due to its position on the western disc. This brings a slight chance of exceeding the S1 Minor Radiation Storm level

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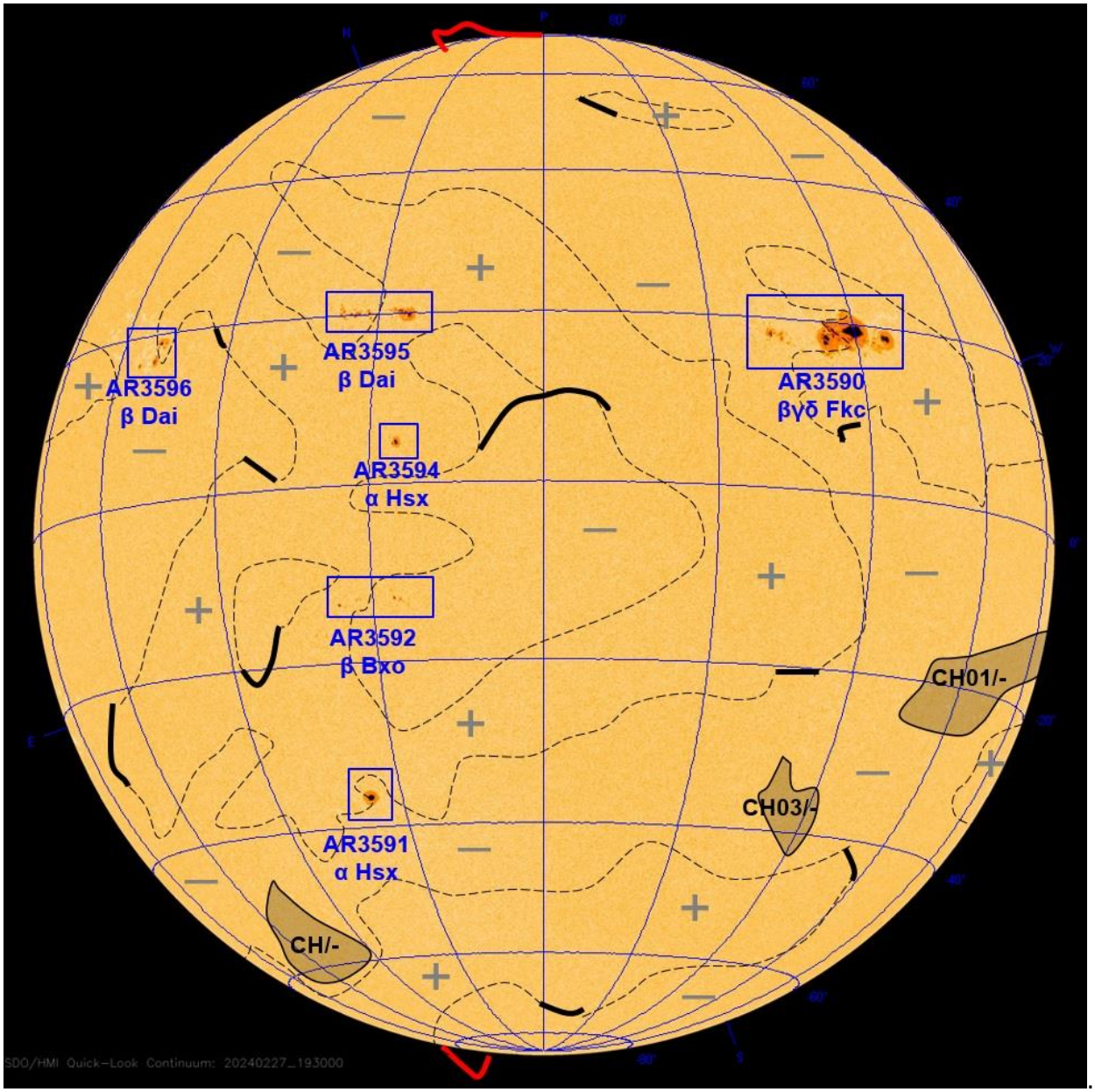
through the period. GOES16 high energy electron flux is expected to remain at background with the associated 24 hr fluence remaining below the Active threshold throughout.

Figure 1. Solar Analysis Valid 27/2000 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

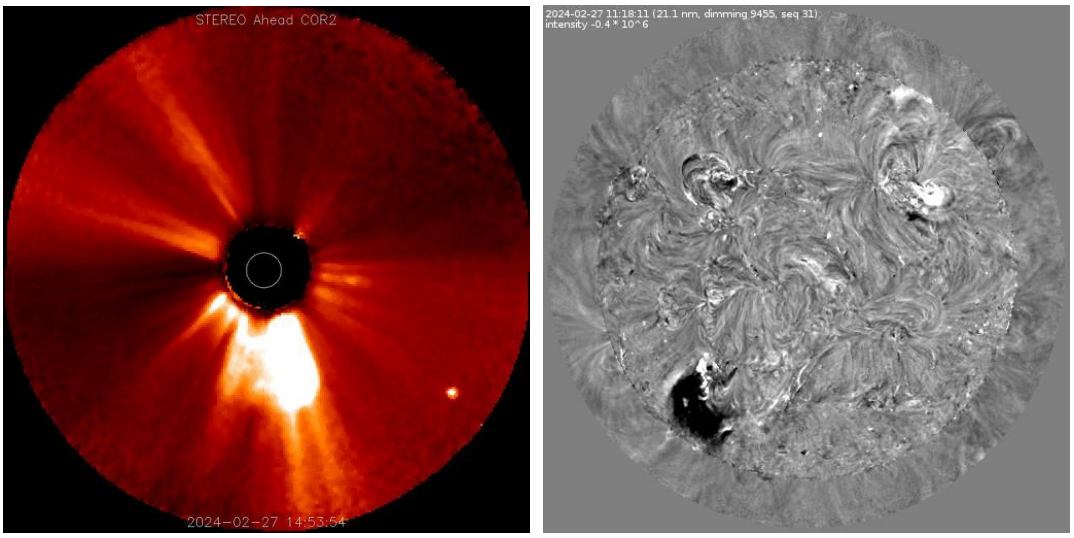
A CME from a filament eruption off the southern-centre disc on 27 Feb is currently under analysis for an Earth-directed component, with SOHO imagery currently not available. Assessment using Stereo A cor2 imagery only suggests this passing south of Earth on day 4 (2 Mar), with a glancing impact at most.

Solar winds are currently slightly elevated, and easing after the recent enhancement from CH01/-. No further notable enhancements are expected with any other coronal holes on the disc too far south to influence Earth. This is supported by MOSWOC enlil which forecasts solar winds to persist at the background to slightly elevated level, between 350 and 450 km/s.

Geomagnetic activity is forecast to be Quiet with a chance of isolated Unsettled intervals. There is a slight chance of Unsettled to Active intervals day 4 (2 Mar) if any CME glance was to occur.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	Yes	1	1	1	5
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Figure 2: St A cor2 (left) showing CME, and associated dimming from solar demon (right)



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Radio Blackouts - X-Ray Flares:

Low to Moderate activity is expected to continue with isolated M-flares. There remains a slight chance of X-class flares from AR3590.

AR3590 is a large region, but has been limited to just a few C-flares during the last 48 hours. A slight reduction in area has been observed, although this may be due to the angle of viewing as the region moves further onto the northwest disc. The magnetic complexity of the region also remains limited, due to its E-W alignment. While mixed polarity regions are contained within the large intermediate penumbra, leading to a delta spot, these polarities continue to follow Hales Law, with the consequence that any twisting of the magnetic loops remains limited. This has also led to the flux on the parity separation line being relatively subdued, and is perhaps a cause of the recent lack of activity. However there are also perhaps tentative signs of this flux increasing, with some umbral development near the parity separation, along with some indication of a sigmoidal shape to the flux loops e.g. in SDO-94. When coupled with the available flux, this suggests further notable flares remain possible.

The other spots on the disc are smaller, however AR3595 and AR3596 are also potential sources of isolated M-class flaring .The former has matured into a standard bipolar E-W aligned group but showing ongoing evolution, while the latter is smaller, and less developmental but does have a N-S alignment that is often indicative of greater activity.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	50	50	50	50
Very Active	R3 to R5 X Class	No	20	20	20	20

Figure 3a: GOES-16/18 X-ray flux

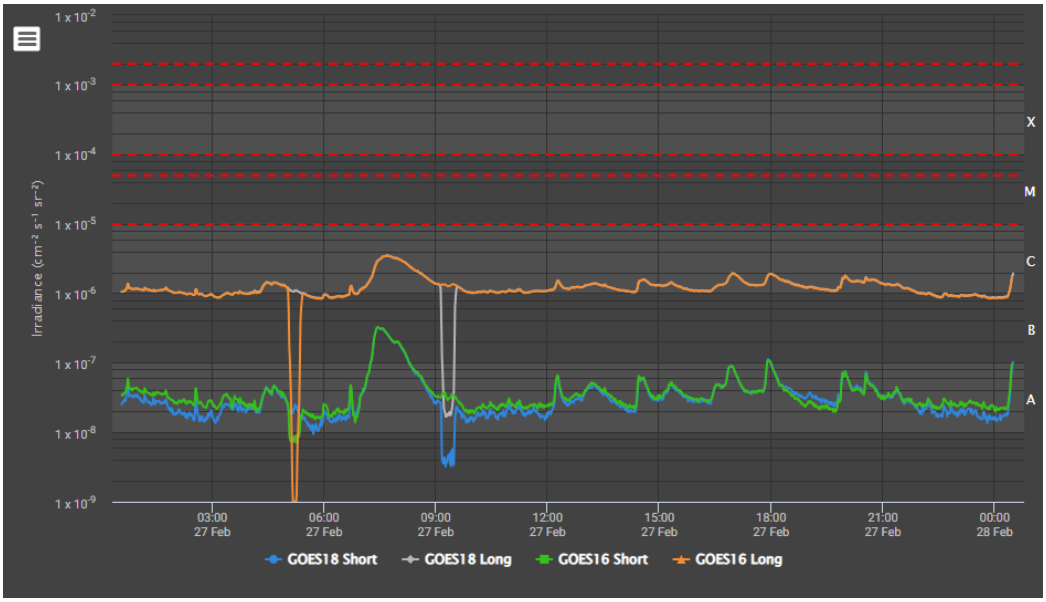

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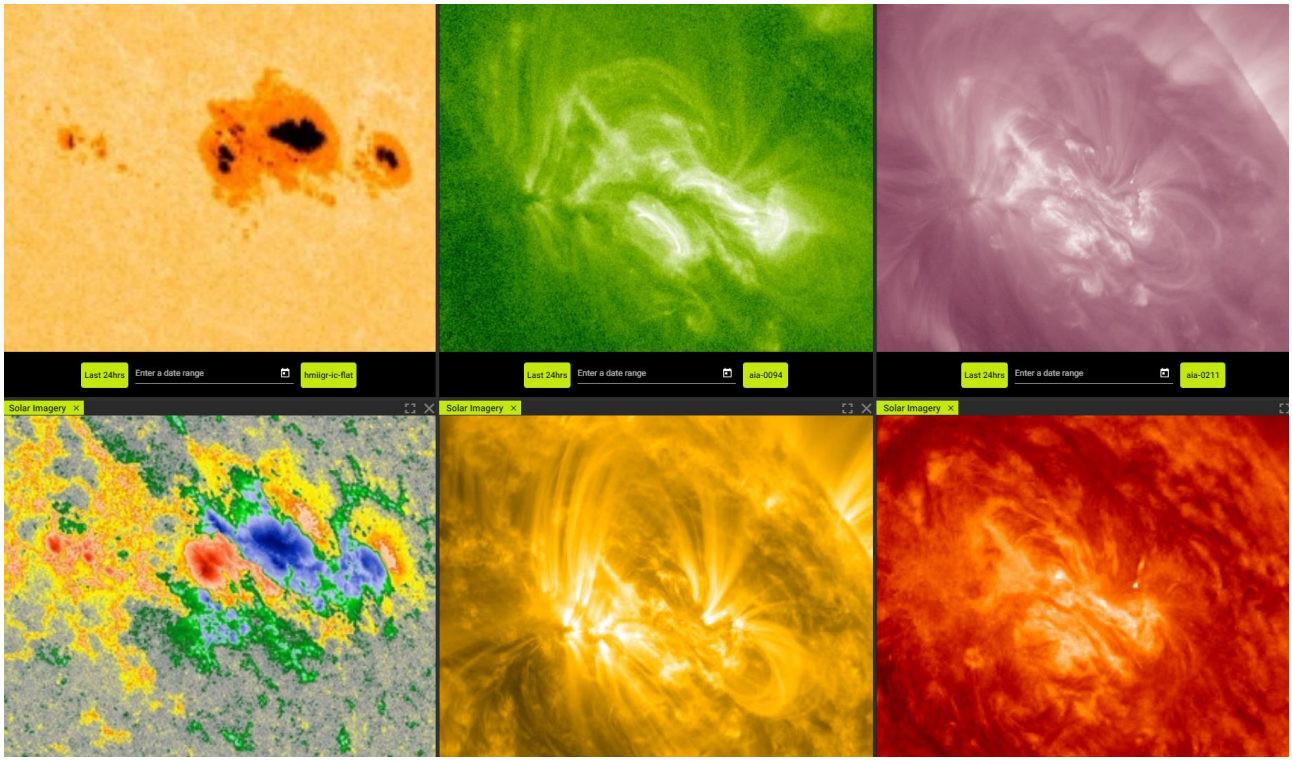
Figure 3b: SDO imagery of AR3590 (Top: Intensitygram, aia-94 and aia 211. Bottom: Magnetogram, aia-171 and aia-304)



Solar Radiation Storms - (High Energy Protons):

GOES-18 proton flux is currently at background, and is expected to persist at this level. There is a slight chance of enhancement as AR3590 moves across the western disc, with this region now in a prime location for any large flares to also result in an observable proton enhancement at Earth. This is low confidence however, due to the regions current relative low activity, and relatively simple configuration despite its size and the presence of a large delta spot.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	15	15	15	15
Very Active	**≥ S3 ***	No	5	5	5	5
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

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High Energy Electrons Event (≥ 2MeV):

High energy electron flux (greater than 2MeV) as observed by GOES-16 is currently background. Recent fast wind enhancement from CH01/+ was a relatively weak affair, despite the observed G1 Minor Storm, and the GOES-16 electron flux is expected to persist at background. No further notable enhancements are forecast

The associated 24 hour fluence is expected to persist at background, with REFM currently giving good guidance to expected conditions.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	No	1	1	1	1
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	1

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